# PATENT SPECIFICATION 762,968

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COMPLETE SPECIFICATION.

## Improvements in Cleaning Devices.

We, S. SMITH & SONS (ENGLAND) LIMITED, a British Company, of Cricklewood Works, Cricklewood, London, N.W.2, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement :—

The present invention relates to apparatus for cleaning dirty articles by subjecting them to the combined action of a liquid cleanser and mechanical agitation. In manufacturing processes it is frequently necessary to remove from a metal article cutting medium and swarf after the completion of one machining operation and prior to the next. Previously such cleaning has been effected by immersing the article (or, if the articles are of a suitable size, numbers of articles) held in a container, such as a wire basket, in a suitable cleaning medium (such as for example trichlorethylene), agitating it and thereafter removing it and allowing to drain. Such a cleansing operation is essentially intermittent and is not conveniently performed in continuous flow production when articles are required to be passed on from one operation to another with little delay. It is accordingly the object of the present invention to provide apparatus for cleaning articles of the kind referred to which is essentially substantially continuous in operation and is suitable for use in continuous flow production.

According to the present invention apparatus for cleaning articles of the kind referred to comprises an elongated carrier adapted to accommodate a plurality of articles, said carrier being adapted to be immersed towards one end below the surface of a cleansing liquid and extend above the said surface towards the other end together with means to apply a vibratory motion to the carrier whereby articles deposited at the end of the carrier below the liquid surface are fed along the carrier and eventually out of the liquid, being subjected to the solvent action of the cleaner and the vibratory motion of the carrier.

Conveniently the carrier may be a trough in the form of a helix, carried on the interior of the wall of a vertical cylindrical drum, the lower part of the drum being normally occupied by cleaning liquid, and the drum and its contents then being subjected to a vibration both about the drum axis and in the direction of the drum axis whereby articles deposited at the lower end of the trough are fed to the upper end thereof.

One form of apparatus in accordance with the invention will now be described with respect to the accompanying drawings, of which :—

Figure 1 shows a sectional view of the apparatus in a vertical plane.

Figure 2 shows a part sectional view on a vertical plane at right angles to that of Figure 1.

The apparatus has a fairly massive first generally rectangular horizontal base plate 1 upon opposite sides of which are mounted vertical pillars 2 and 3. A second base plate 4 is mounted upon the first, by means of resilient pads indicated at 5, 6, 7. An electro-magnet 8 is centrally disposed upon base plate 4. It has an E-shaped core 9, upon the central limb of which is disposed an exciting winding 10. Base plate 4 also carries, symmetrically arranged about the axis of the electro-magnet, three similar elongated laminated steel members 11, 12, 13, each making an angle of about 45° with the plate, and the three members being disposed somewhat in the configuration of a three start right-handed screw about the axis of electromagnet 8. The ends of the members remote from the plate are attached to the base of a cylindrical metal drum 14, whose axis coincides with that of electro-

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magnet 8. An I-shaped armature 15 is attached to the base of drum 14 and lies over, but normally slightly displaced from, the ends of the limbs of core 9. The drum 14 is liquid-tight, and is open at its upper end (16), which lies rather below the upper ends of the pillars 2 and 3. A shallow trough 17 in the form of a left-handed helix is attached to the inside of the vertical curved wall of drum 14, its lower end being adjacent the case and its upper end adjacent the open end of the drum. The upper end is provided with a discharge lip 18. The width of the trough is conveniently about one-eighth of the drum diameter, and conveniently the pitch of the helix is about twice the width of the trough.

A bridging member 19 connects the pillars 2 and 3 adjacent their upper ends. This carries a cover 20 arranged to enclose, but not touch, the open end of drum 14. The hood in its turn carries a feed member in the general form of a rectangular vertical tube 21 open at either end, with a hopper 22 at its upper end and a curved portion 23 at its lower end, arranged adjacent to the lower end of trough 17, but not touching this, so that articles fed into the hopper 22 are fed on to trough 17. An electric heating element 24 is supported from bridging member 19 by means of a tube 25, which accommodates the electric leads to the element. A thermostat 26 is supported from bridging member 19, and controls the flow of electricity to the heating element 24. A coiled tube 27 is disposed towards the top of drum 14, being also supported from bridging member 19, and is adapted to be supplied with a cooling medium, most conveniently cold water, through pipes 28, 29. A vertical tube 30, supported from bridging member 19, carries at its lower end a pump 31, which is driven by means of a shaft 32 situated within tube 30. The inlet of the pump is indicated at 33, and liquid delivered by the pump passes up pipe 34 and eventually through outwardly-directed jet 35. An electric motor 36, mounted on member 19, is coupled to the upper end of shaft 32 through a flexible coupling 37.

In operation the lower part of drum 14 is filled with a suitable cleansing liquid, such as trichlorethylene, electricity is supplied to the heating element 24 and the electromagnet winding 10 is supplied with normal supply frequency alternating current (e.g. 50—60 c/s.).

The heating element 24 and thermostat 26 maintain the correct operating temperature for the liquid, and the drum has imparted to it an oscillatory motion having components both in the direction of the drum axis and about that axis, under the influence of the electromagnet 8 and spring members 11, 12, 13. As the flux produced by the magnet approaches its maximum during any half-cycle of the exciting current, drum and trough move downwards and clockwise (as viewed from below). A small article originally placed in the trough 17 thus momentarily loses contact with the trough, and regains contact at a point slightly further towards the upper end of the trough (owing to the opposite senses of the configuration of 11, 12, 13 and the helix of trough 17). Thus it is gradually fed along the trough towards its upper end. Articles to be cleaned, therefore, are fed into hopper 22, fall down tube 22, are directed on to the lower end of trough 17 and are fed upwards, at first under the liquid (where they are cleaned by the joint effects of the liquid and the vibration of the trough), subsequently past the stream of liquid issuing from jet 35 (which assists in washing off particles of swarf etc.) finally draining, and drying by their own residual heat before being fed out over lip 18. It is probable that cavitation, produced by the vibration, materially assists the cleaning process. Vapour from the liquid is condensed upon coiled tube 27, and drops back to the bottom of the drum. It may be found in certain circumstances that the additional cleaning effect of the stream issuing from jet 35 is not required, in which case motor 36 will be kept stationary.

It will be appreciated that none of the components carried by bridging member 19 are in direct mechanical contact with drum 14 or trough 17. The second base plate 4, resiliently mounted with respect to the first base plate 1, is found to be extremely desirable. If the electromagnet 8 and members 11, 12, 13 are attached directly to the first base plate 1 the vibrating system constituted by base plate, drum etc. is tightly coupled to any bench or the like upon which the apparatus is placed, and the result may be that articles will not be fed properly along the trough.

It may be arranged, by, for example the provision of a sump under the cooling coil in which the pump inlet is situated, that the jet of cleaning liquid consists of condensed cleaning liquid vapour and is thus free from contamination by oil etc. dissolved in the main bulk of cleaning liquid. This is in certain circumstances very desirable. Apparatus in accordance with the present invention is particularly useful in connection with the flow production of relatively small components such as are used in clocks and instruments. Components from one machine may be fed continuously into apparatus in accordance with the invention and from that apparatus continuously to the next machine, there thus being no discontinuous cleaning process to break the flow.

What we claim is :—

1. Cleaning apparatus of the kind referred

to comprising an elongated carrier adapted to accommodate a plurality of articles, said carrier being adapted to be immersed towards one end below the surface of a cleaning liquid and extend above the said surface towards the other end together with means to apply a vibratory motion to the carrier whereby articles deposited at the end of the carrier below the liquid surface are fed along the carrier and eventually out of the liquid, being subjected to the solvent action of the cleaner and the vibratory motion of the carrier.

2. Apparatus as claimed in Claim 1 wherein the vibratory motion of the carrier has components both normal to its length and along its length, motion in the downward direction normal to its length being accompanied by motion in the direction of its downward slope.

3. Apparatus as claimed in Claim 2 comprising a cylindrical drum adapted to be disposed with its axis vertical and be partially filled with cleaning fluid, the carrier being a trough in the form of a helix and the means to apply a vibratory motion to the carrier comprising means to apply a vibration to the drum both about its axis and along its axis.

4. Apparatus as claimed in Claim 3 wherein the means to apply a vibration to the drum comprise a plurality of similar elongated elastic members, each of said members having one end attached to the base of the drum and the other attached to a base plate, said elongated elastic members being arranged in the configuration of a screw about the axis of the drum, the sense of said screw being opposite to the sense of the helix, and means to produce a periodic force between the base of the drum and the said base plate.

5. Apparatus as claimed in Claim 4 wherein the means to produce a periodic force comprise an electromagnet adapted to be energised with alternating current and an armature co-operating with said electromagnet, one of which is attached to the base plate and the other to the base of the drum.

6. Apparatus as claimed in Claim 4 or 5 wherein the base plate is resiliently mounted upon a further base plate.

7. Apparatus as claimed in any of the preceding claims comprising means to heat the cleansing liquid.

8. Apparatus as claimed in Claim 7 comprising means to condense vapour arising from the said liquid and return it to the lower portion of said drum.

9. Apparatus as claimed in any of the preceding claims comprising means to direct a stream of cleansing liquid along the carrier.

10. Apparatus as claimed in Claim 7 comprising means to condense vapour arising from said liquid, a sump, adapted to contain condensate from said means, and means to direct a stream of said condensate along the carrier.

11. Apparatus as claimed in Claim 6 comprising a member rigidly located with respect to said further base plate and adjacent the upper end of the drum, said member not being in direct mechanical contact with said drum, means supported by said member and disposed adjacent the bottom of the drum to heat cleansing liquid contained therein, and means supported by said member and disposed within the drum to condense vapour arising from the liquid.

12. Apparatus as claimed in Claim 11 comprising means supported by said member and disposed within the drum to direct a stream of cleansing liquid along the helical trough.

13. Cleansing apparatus substantially as hereinbefore described and as shown in the accompanying drawings.

For the Applicants :
E. SWINBANK,
Chartered Patent Agent.

PROVISIONAL SPECIFICATION.

## Improvements in Cleaning Devices.

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The present invention relates to apparatus for cleaning dirty articles by subjecting them to the combined action of a liquid cleanser and mechanical agitation. In manufacturing processes it is frequently necessary to remove from a metal article cutting medium and swarf after the completion of one machining operation and prior to the next. Previously such cleaning has been effected by immersing the article (or, if the articles are of a suitable size, numbers of articles) held in a container, such as a wire basket, in a suitable cleansing medium (such as for example trichlorethylene), agitating it and thereafter removing it and allowing it to drain. Such a cleansing operation is essentially intermittent and is not conveniently performed in continuous flow production when articles are required to be passed on from one operation to another with little delay. It is accordingly the object of the present invention to provide apparatus for cleaning articles of the kind referred to which is essentially substantally

continuous in operation and is suitable for use in continuous flow production.

According to the present invention apparatus for cleaning articles of the kind referred to comprises an elongated carrier adapted to accommodate a plurality of articles, said carrier being adapted to be immersed adjacent one end below the surface of the cleansing liquid and extending above the said surface towards the other end together with means to apply a vibratory motion to the carrier whereby articles deposited at the end of the carrier below the liquid surface are fed along the carrier and eventually out of the liquid, being subjected to the solvent action of the cleaner and the vibration of the carrier.

Conveniently the carrier may be a trough in the form of a helix, carried on the interior of the wall of a vertical cylindrical drum, the lower part of the drum being normally occupied by cleaning liquid, and the drum and its contents then being subjected to a vibration both about the drum axis and in the direction of the drum axis whereby articles deposited at the lower end of the trough are fed to the upper end thereof.

One form of apparatus constructed in accordance with the present invention will now be described.

The apparatus has a fairly massive first rectangular horizontal base plate, upon opposite sides of which are mounted two vertical pillars. A second horizontal base plate is resiliently mounted upon the first, and carries, centrally disposed thereon, an electromagnet whose axis is vertical. It also carries, symmetrically distributed about the axis of the electromagnet, three similar elongated spring steel members, making an angle of about 45° with the base plate and being disposed somewhat in the configuration of a three-start right handed screw about the electro-magnet axis. The ends of the members remote from the second base plate are attached to the base of a cylindrical metal drum, coaxial with the electro-magnet. An armature, centrally disposed on the base of the drum, co-operates with the electro-magnet. The drum is liquid-tight, and is open at its upper end, which lies rather below the upper ends of the pillars mentioned earlier. A shallow trough in the general form of a left-handed helix is attached to the inside of the curved wall of the drum, its lower end being adjacent the base and its upper end being adjacent the upper end of the drum. The upper end is provided with a discharge lip. The width of the trough is conveniently about one-eighth of the drum diameter, while the pitch of the helix is conveniently about twice the width of the trough.

A bridging member connects the upper ends of the pillars referred to earlier. This carries a cover arranged to enclose, but not touch, the open end of the drum. It also carries a feed member in the general form of a vertical rectangular tube, open at both ends, being provided at its upper end with a hopper and being so shaped at its lower end as to feed articles dropped down it on to the spiral trough near its lower end. A heating element, positioned near the base of the drum and a thermostat arranged to control the supply of electricity to the heating element to maintain the temperature constant are also carried by the bridging member, as are cooling coils arranged to be fed with cold water which are disposed towards the upper end of the drum. An electric motor, also mounted on the bridging member, drives a pump whose inlet is adjacent the base of the drum and which is capable of delivering fluid to an outwardly directed jet towards the upper end of the drum.

In operation the lower part of the drum is filled with a suitable cleansing liquid, such as trichlorethylene, electricity is supplied to the heater and the motor, and the electro-magnet is supplied with normal supply frequency alternating current (e.g. 50 c/s.).

The heater element and thermostat maintain the correct operating temperature for the liquid, while the drum has imparted to it an oscillatory motion having components both in the direction of the drum axis and about that axis, under the influence of the electro-magnet and the spring members. Articles to be cleaned are fed into the hopper and thence on to the helical trough, being fed upwards along the trough, at first under the liquid (where they are cleaned by the joint effects of the liquid and the vibration of the trough), subsequently past the jet of liquid (washing off any adherent particles of swarf etc.) finally draining and drying by their own residual heat before being fed out over the lip. It is probable that cavitation, occurring under the influence of the vibration, materially assists the cleaning process. Vapour from the liquid is condensed upon the cooling coils. It may be found in certain circumstances that the additional cleaning effect of the liquid jet is not required.

It will be appreciated that none of the components carried by the bridging member are in direct mechanical contact with the drum or the trough. It is found extremely desirable in practice to have the second resiliently mounted base plate. If the electro-magnet etc., are attached directly to the first base plate the vibrating system constituted by base plate and drum is tightly coupled to any bench, etc. upon which the apparatus is placed, and the result may be that articles will not be fed properly along the trough.

It may be arranged, by, for example the provision of a sump under the cooling coil in which the pump inlet is situated, that the

jet of cleaning liquid consists of condensed cleaning liquid vapour and is thus free from contamination by oil etc. dissolved in the main bulk of cleaning liquid. This is in certain circumstances very desirable. Apparatus in accordance with the present invention is particularly useful in connection with the flow production of relatively small components such as are used in clocks and instruments. Components from one machine may be fed continuously into apparatus in accordance with the invention and from that apparatus continuously to the next machine, there thus being no discontinuous cleaning process to break the flow.

For the Applicants :
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Chartered Patent Agent.

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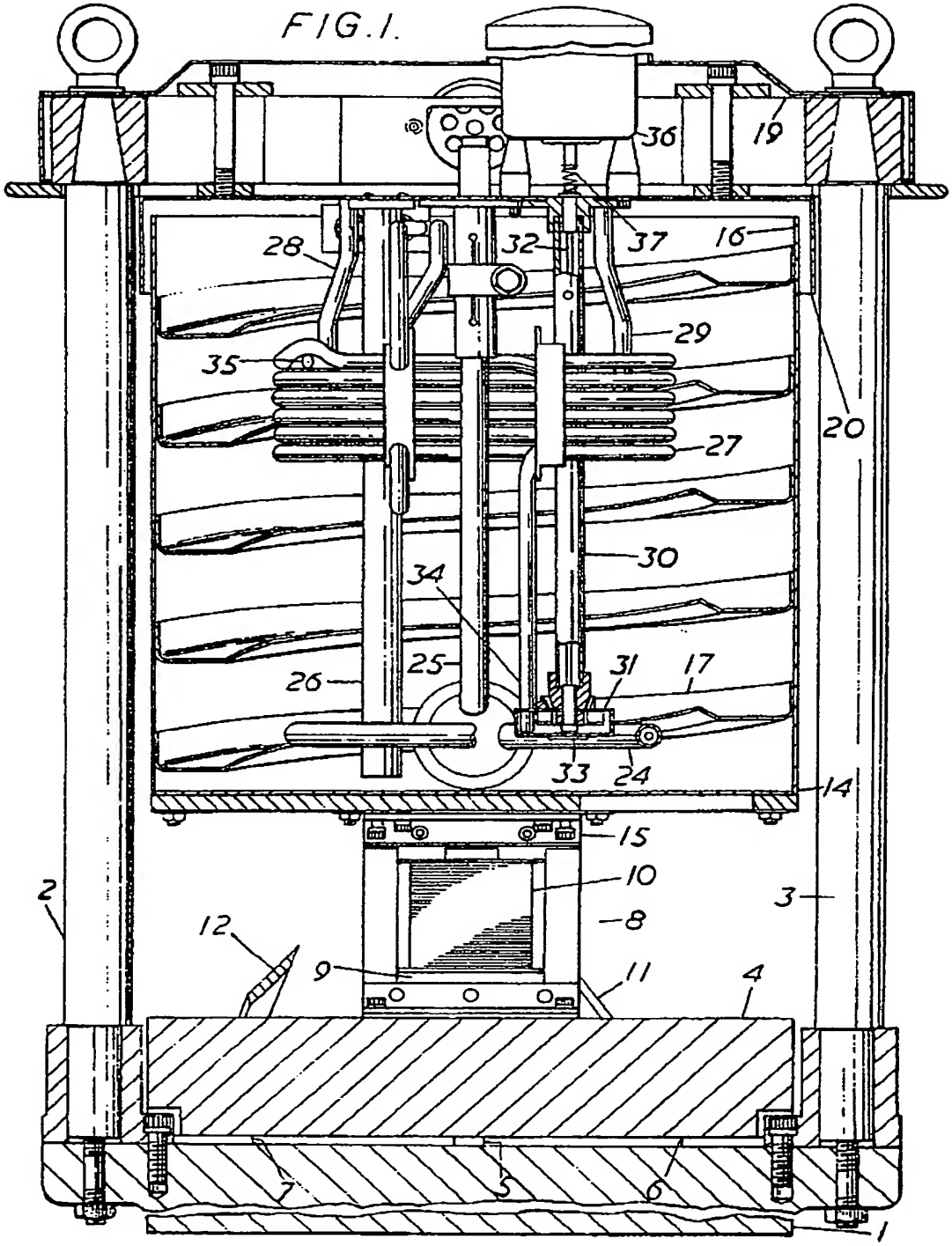
FIG. 1.



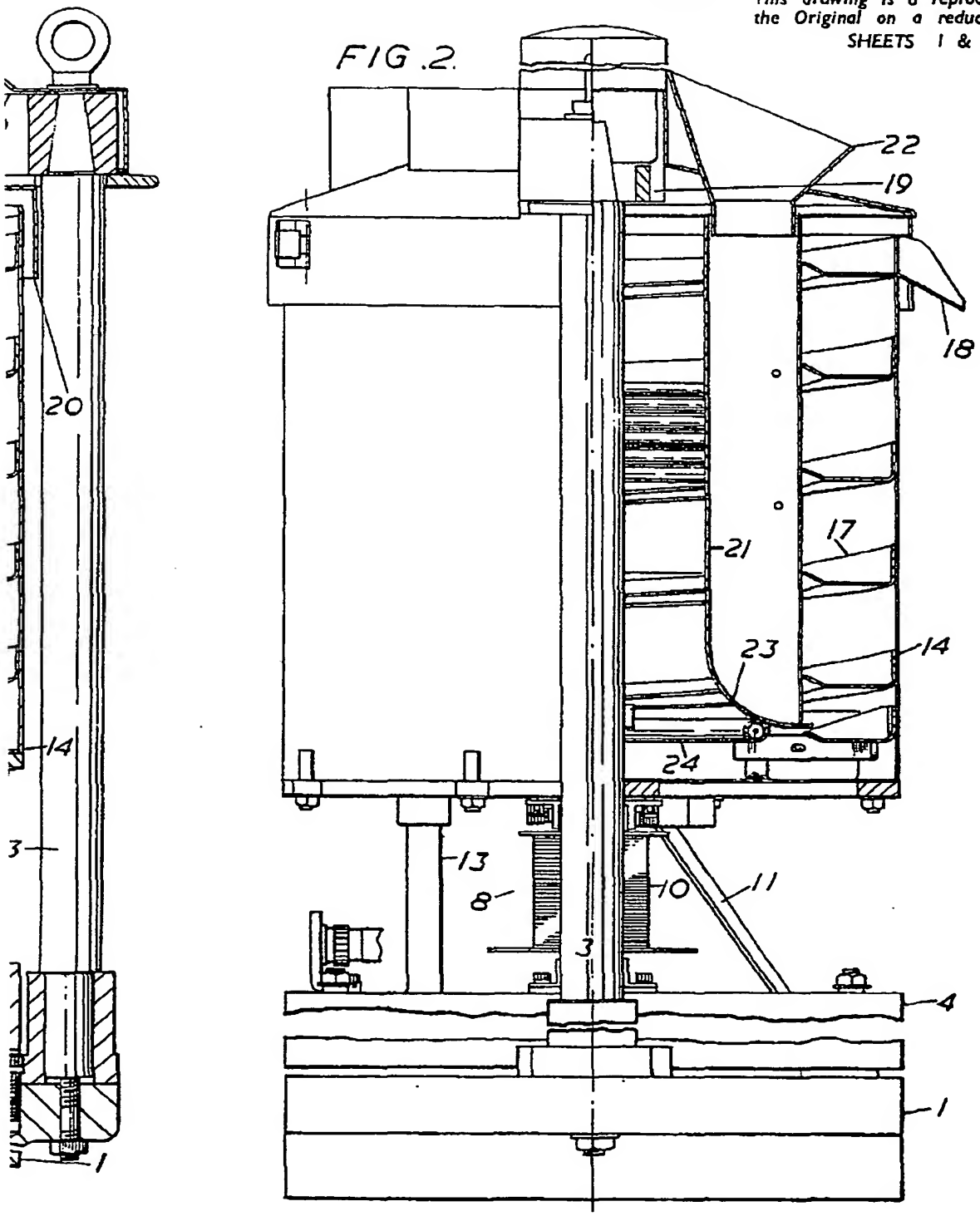
762,968 COMPLETE SPECIFICATION

2 SHEETS

*This drawing is a reproduction of the Original on a reduced scale.*

SHEETS 1 & 2

FIG. 2.



762,968 COMPLETE SPECIFICATION
2 SHEETS This drawing is a reproduction of the Original on a reduced scale.
SHEETS 1 & 2

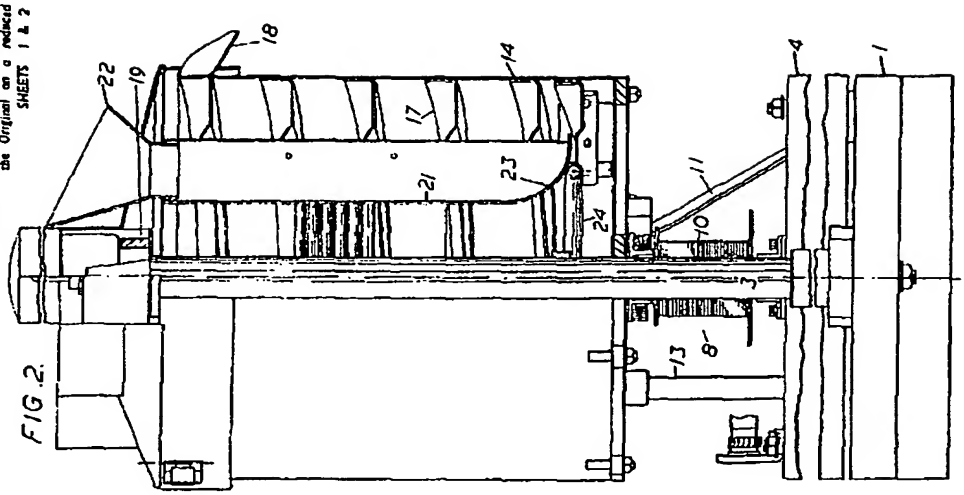



FIG.2.

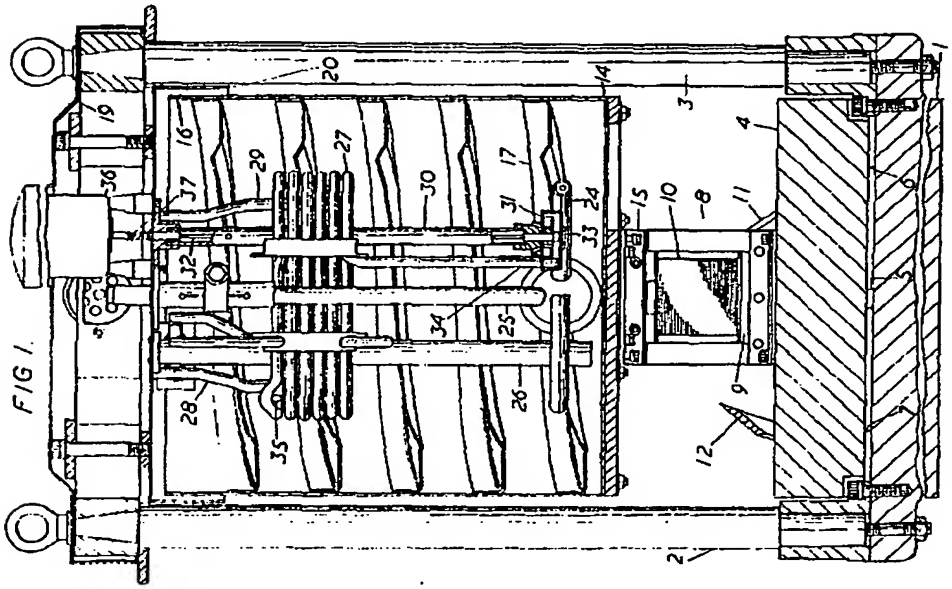



FIG 1.